In re Patent Application of
KIRSCH ET AL.
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In the Claims:

Claims 1-12 (Cancelled).

13. (New) A method for controlling frequency of a local oscillator in a DS-CDMA type receiver, the method comprising:

transforming a known spread spectrum signal into a sampled digital signal formed of symbols with a despreaded frequency spectrum;

determining a residual frequency error f_e for each symbol including a first residual frequency error f_{e1};

filtering the residual frequency errors;

correcting the frequency of the local oscillator with the filtered residual frequency errors;

storing the first determined residual frequency error f_{e1};

determining an average of absolute values of a predetermined number of successive residual frequency errors; and

comparing the average with a threshold, and if the average is greater than or equal to the threshold, the local oscillator frequency is corrected using an error equal to $-\mathrm{sgn}(f_{e1})(1/T - |f_{e1}|)$, where sgn is the sign function, $|\ \ |$ is the absolute value function and T is duration of a symbol before determining the next residual frequency error associated with the next symbol.

14. (New) A method according to Claim 13, wherein the residual frequency errors are digitally filtered with a digital filter, and if the average is greater than the

threshold, the digital filter is set to zero before a next residual frequency error is filtered.

15. (New) A method according to Claim 13, wherein the residual frequency errors are filtered with a first order matching filter.

16. (New) A method according to Claim 13, wherein a current correction applied to the local oscillator is equal to (1-b) times a previous correction plus b times a current residual frequency error, and the coefficient b is chosen to be close to 1 if the current residual frequency error is greater than a first predetermined limiting value, and the coefficient b is chosen to be close to zero if the current residual frequency error is less than a second predetermined limiting value.

17. (New) A method according to Claim 16, wherein the first and second predetermined limiting values are equal to the symbol rate divided by 7.

18. (New) A device for controlling frequency of a local oscillator in a DS-CDMA type receiver comprising pre-processing means for transforming a known spread spectrum signal into a sampled digital signal formed of symbols with a despreaded frequency spectrum, the device comprising:

first calculation means for determining a residual frequency error f_e for each symbol including a first residual frequency error f_{e1};

filter means for filtering the residual frequency errors;

correction means for correcting the frequency of the local oscillator with the filtered residual frequency errors;

memory means for storing the first residual frequency error f_{e1};

second calculation means for determining an average of absolute values of a predetermined number of successive residual frequency errors; and

comparison means for comparing the average with a threshold, and if the average is greater than or equal to the threshold, the local oscillator frequency is corrected using an error equal to $-\text{sgn}(f_{e1})(1/T - |f_{e1}|)$, where sgn is the sign function, $|\ \ |$ is the absolute value function and T is duration of a symbol before determining the next residual frequency error associated with the next symbol.

19. (New) A device according to Claim 18, wherein said filtering means comprises a digital filter; and further comprising control means for resetting said digital filter to zero before filtering a next residual frequency error if the average is greater than the threshold.

20. (New) A device according to Claim 18, wherein said filtering means comprises a first order matching filter.

21. (New) A device according to Claim 18, wherein a current correction applied to the local oscillator is equal to (1-b) times a previous correction plus b times a current residual frequency error, and the coefficient b is chosen to be close to 1 if the current residual frequency error is greater than a first predetermined limiting value, and the

coefficient b is chosen to be close to zero if the current residual frequency error is less than a second predetermined limiting value.

22. (New) A device according to Claim 21, wherein the first and second predetermined limiting values are equal to the symbol rate divided by 7.

23. (New) A device according to Claim 18, wherein said first calculation means, said filter means, said correction means, said memory means, said second calculation means and said comparison means are implemented within a processor.

24. (New) A receiver comprising:

pre-processing circuitry for transforming a known spread spectrum signal into a sampled digital signal formed of symbols with a despreaded frequency spectrum;

a local oscillator connected to said pre-processing circuitry; and

a device for controlling frequency of said local oscillator, said device comprising

a first calculation circuit for determining a residual frequency error f_e for each symbol including a first residual frequency error f_{e1},

a correction circuit for correcting the frequency of the local oscillator with the residual frequency errors,

a second calculation circuit for determining an average of absolute values of a predetermined number of successive residual frequency errors, and

a comparison circuit for comparing the average with a threshold, and if the average is greater than or equal to the threshold, the local oscillator frequency is corrected using an error equal to $-\text{sgn}(f_{e1})(1/T - |f_{e1}|)$, where sgn is the sign function, $|\ \ |$ is the absolute value function and T is duration of a symbol before determining the next residual frequency error associated with the next symbol.

25. (New) A receiver according to Claim 243 wherein said device further comprises a memory for storing the first residual frequency error f_{e1}.

26. (New) A receiver according to Claim 24 wherein said device further comprises a filter for filtering the residual frequency errors.

27. (New) A receiver according to Claim 26, wherein said filter comprises a digital filter; and wherein said device further comprises a control circuit for resetting said digital filter to zero before filtering a next residual frequency error if the average is greater than the threshold.

28. (New) A receiver according to Claim 26, wherein said filter comprises a first order matching filter.

29. (New) A receiver according to Claim 24, wherein a current correction applied to said local oscillator is equal to (1-b) times a previous correction plus b times a current

residual frequency error, and the coefficient b is chosen to be close to 1 if the current residual frequency error is greater than a first predetermined limiting value, and the coefficient b is chosen to be close to zero if the current residual frequency error is less than a second predetermined limiting value.

30. (New) A receiver according to Claim 29, wherein the first and second predetermined limiting values are equal to the symbol rate divided by 7.

31. (New) A receiver according to Claim 24, wherein the receiver is integrated within a mobile cell phone.

32. (New) A mobile cell phone comprising:

an antenna; and

a receiver connected to said antenna for receiving a known spread spectrum signal, said receiver comprising

pre-processing circuitry for transforming the spread spectrum signal into a sampled digital signal formed of symbols with a despreaded frequency spectrum,

a local oscillator connected to said pre-processing circuitry, and

a processor for controlling frequency of said local oscillator by

determining a residual frequency error f_e for each symbol including a first residual frequency error f_{e1},

filtering the residual frequency errors,

correcting the frequency of the local

oscillator with the filtered residual frequency errors,

storing the first determined residual frequency error f_{e1},

determining an average of absolute values of a predetermined number of successive residual frequency errors, and

comparing the average with a threshold, and if the average is greater than or equal to the threshold, the local oscillator frequency is corrected using an error equal to $-sgn(f_{e1})(1/T - |f_{e1}|)$, where sgn is the sign function, $|\ \ |$ is the absolute value function and T is duration of a symbol before determining the next residual frequency error associated with the next symbol.

33. (New) A mobile cell phone according to Claim 32 wherein said receiver comprises a DS-CDMA type receiver.

34. (New) A mobile cell phone according to Claim 32 wherein said processor comprises a memory for storing the first residual frequency error f_{e1}.

35. (New) A mobile cell phone according to Claim 32 wherein said processor filters the residual frequency errors before correcting the frequency of the local oscillator.

36. (New) A mobile cell phone according to Claim 35, wherein said processor resets the filtering to zero before

filtering a next residual frequency error if the average is greater than the threshold.

37. (New) A mobile cell phone according to Claim 35, wherein the filtering corresponds to a first order matching filter.

38. (New) A mobile cell phone according to Claim 32, wherein a current correction applied to said local oscillator is equal to (1-b) times a previous correction plus b times a current residual frequency error, and the coefficient b is chosen to be close to 1 if the current residual frequency error is greater than a first predetermined limiting value, and the coefficient b is chosen to be close to zero if the current residual frequency error is less than a second predetermined limiting value.

39. (New) A mobile cell phone according to Claim 38, wherein the first and second predetermined limiting values are equal to the symbol rate divided by 7.